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Marine Aviation Requirements Study: MEU ACE Analysis

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Contents

Summary

This research memorandum describes the analysis of the requirements for the Marine Expeditionary Unit (MEU) aviation combat element (ACE) in the 2015-plus time frame. This analysis was conducted as part of the Marine Aviation Requirements Study (MARS) by the Center for Naval Analyses (CNA). The MARS was tasked to determine Marine Corps aviation requirements, with an emphasis on aircraft, based on a major theater war (MTW), small-scale contingency (SSC) operations, MEU(SOC) operations, and peacetime requirements for the 2015-plus time frame.

We developed MEU ACE requirements from an analysis of MEU missions and a MEU NEO scenario developed by the Marine Corps. We also examined the types of missions that different MEU ACE aircraft might be called upon to perform in support of the MEU.

Table 1 summarizes the number of aircraft required for the future MEU ACE, based on our analysis of a NEO scenario. This is potentially the most aviation-intensive mission a MEU is likely to perform. The requirement takes aircraft availability into account.

Table 1 also compares the current MEU ACE to the future requirement, which is larger. In the future, the MV-22 and Joint Strike Fighter (JSF) will greatly increase the operational reach of the MEU (because aircraft ranges are longer than those of their predecessors as well as the multi-mission capabilities of the JSF).

Table 1. Future MEU ACE aircraft requirement

Aircraft type	Current structure	Requirement
MV-22	12	14
CH-53E	4	6
AH-1Z	4	6
UH-1Y	2	3
JSF	6[a]	10
KC-130	2[b]	2
VTUAV	0[c]	1 system

a. The current MEU ACE includes a detachment of six AV-8Bs. The Marine Corps intends to replace all its AV-8Bs with JSF aircraft.
b. This two-plane detachment is not deployed aboard the ARG with the rest of the MEU. It remains in the continental United States as a stand-by detachment, which can be forward-deployed in support of the MEU, at the MEU commander's discretion.
c. There are currently no unmanned aerial vehicles in the MEU ACE. The VTUAV system is a new system that will be in the Marine Corps in the 2015 time frame.

The MEU ACE requirement is an important component of the overall Marine aviation requirement. MEU deployments account for the bulk of rotary-wing rotational deployments, which are a significant determinant of peacetime squadron requirements.

Introduction

This research memorandum documents the Marine Expeditionary Unit (MEU) Aviation Combat Element (ACE) requirements analysis performed by the Center for Naval Analyses' (CNA's) Marine Aviation Requirements Study (MARS). MARS was sponsored by the Deputy Commandant for Aviation and the Deputy Commanding General for Combat Development, Marine Corps Combat Development Command, for the purpose of determining the Marine Corps' aircraft force structure requirements in the 2015 time frame. This research memorandum is one in a series of reports that document various detailed analysis for the MARS. Reference [1] is our analysis of Marine Corps peacetime squadron requirements. Reference [2] is the MARS summary report, which integrates MEU ACE requirements with MTW, SSC, and peacetime operations requirements to develop overall Marine aviation requirements. References [3,4] also document various detailed analyses for the MARS.

The Marine Corps' aviation force structure must accommodate aviation requirements for different types of MAGTFs and different levels of operations. The MARS analyzed Marine aircraft requirements for an MTW, SSC, MEU operations, and peacetime operations. Overall Marine aviation force structure requirements are also described in the study's summary report, [2].

Analytic objectives and issues

The purpose of this analysis is to determine MEU aircraft requirements in the 2015 time frame.

While the basic composition and missions of the MEU are not expected to change significantly in the near future, new aircraft will enter the Marine Corps' inventory. The Marine Corps plans to replace its current medium-lift helicopters, the CH-46Es and CH-53Ds, with a new tilt-rotor aircraft, the MV-22. In addition, the Marine

Corps plans to replace its AV-8B attack aircraft with the Joint Strike Fighter (JSF), which will also replace the F/A-18C and F/A-18D.

The composition of the MEU ACE is important for several reasons. Forward-deployed MEUs provide forward presence around the world, and represent a significant rapid response contingency capability for the National Command Authority. The rotational MEU deployments are a significant component of the Marine Corps peacetime operational tempo, and a portion of the force structure is devoted to these commitments. Furthermore, the MEU's footprint is an important determinant of the type of ships and the ship mix in the Navy's amphibious ship fleet.

Analytic approach

We examined current MEU missions and capabilities to understand the current role of the MEU ACE. We analyzed a specific, representative scenario and determined the number of aircraft required to accomplish the MEU's concept of operations in that scenario. We also conducted a sensitivity analysis of the scenario's aircraft requirements, and we examined other implications of the MEU's missions and capabilities for MEU ACE aircraft requirements.

The key assumption we make in our analysis is that the missions that MEUs will be required to conduct in the 2015 time frame will be similar to those they currently perform.

Current MEU ACE

This section describes the current roles and missions, capabilities, and structure of the current MEU ACE. The current MEU ACE provides a baseline against which to assess future requirements, and a point of departure for analysis of future MEU ACE requirements.

Current MEU missions

We examined the MEU's current required mission capabilities, and characterized aviation requirements for them. MEU(SOC) mission capabilities are specific by Marine Corps order, 3120.9A, [5]. We also examined a current MEU SOP, [6]. The MEU(SOC) missions are grouped into four broad categories:

- Amphibious operations
- Direct action operations
- Military operations other than war (MOOTW)
- Support operations.

The mission capabilities are presented in table 2. While these required capabilities encompass a broad range of operations, it is important to remember that the primary emphasis of the MEU(SOC) program and the deployed MEU's primary role is to: "provide forward-deployed units which offer unique opportunities for a variety of quick reaction, sea-based, crisis response options, in either a conventional amphibious role, or in the execution of selected maritime special operations" [5].

In table 2, we have indicated which missions typically include a significant role for each of the six functions of Marine aviation, and in this case what the MEU ACE may be called upon to provide with organic assets: assault support (AST), offensive air support (OAS), anti-air warfare (AAW), air reconnaissance (Recce), airborne command and

control (C2), and electronic warfare (EW) in the context of quick-reaction, crisis-response options. Of course, for any given mission, the threat or situation will dictate the level of aviation support required.

MEU amphibious operations will likely take place as part of a larger contingency. An example of this would be an amphibious raid in support of an amphibious campaign during an MTW.

MEU direct action operations are usually performed by highly trained units within the MEU, and typically require very limited aviation support. Examples of this include VBSS, which is performed by the Maritime Special Purpose Force, or TRAP missions, which are performed by a specially designated TRAP team.

MEU MOOTW operations will generally be conducted as part of a larger operation—primarily because these are generally sustained operations that require a "quick-reaction crisis response" only initially. One exception, however, is non-combatant evacuation operations (NEOs). NEOs are generally limited in duration, and by their nature necessitate a quick-reaction, crisis response.

MEU support operations that could have a significant role for aviation include military operations in urban terrain (MOUT), airfield/port seizure, and show-of-force operations. The first two are likely to be limited in duration or part of a larger operation. Show-of-force operations, while important, are probably not the soundest foundation upon which to base force structure requirements.

Table 2. Functions of Marine aviation that play a significant role in MEU missions[a]

MEU missions	Functions of Marine aviation					
	AST	OAS	AAW	Recce	Air C2	EW
Amphibious Operations						
Assault	X	X	X	X	X	X
Raid		X	X	X	X	X
Demonstration	X	X	X	X	X	
Withdrawal	X	X	X	X	X	X
Direct Action Operations						
In-Extremis Hostage Rescue	X			X		
Seizure/Recovery of GOPLATs	X					
Visit, Board, Search & Seizure Ops	X					
Specialized Demolition Ops						
Tactical Recovery of Aircraft & Personnel	X		X	X	X	
Seizure/Recovery of Personnel & Material						
Counter proliferation of WMD						
Military Operations Other than War (MOOTW)						
Peace Operations	X					
Security Operations	X					
Non-combatant Evacuation Operations (NEO)	X					
Reinforcement Operations	X					
Joint/Combined Training/Instruction Team						
Humanitarian Assistance/Disaster Relief		X				
Support Operations						
Tactical Deception Operations						
Fire Support Planning, Coordination & Control in Joint/Combined Environment						
Signal Intelligence/Electronic Warfare						
Military Operations in Urban Terrain (MOUT)	X	X	X	X	X	
Reconnaissance & Surveillance						
Initial Terminal Guidance						
Counterintelligence Operations						
Airfield/Port Seizure	X	X	X	X	X	
Limited Expeditionary Airfield Operations			X			
Show of Force Operations						

a. MEU missions are from Marine Corps Order 3120.9A with Change 1, *Policy for Marine Expeditionary Units (Special Operations Capable) (MEU(SOC))*, November 1997 [5], and 26th MEU(SOC), *Standard Operating Procedures (SOP)* (U), Secret, 2001 [6].

MEU ACE role

The current MEU ACE is a reinforced HMM squadron that typically includes the following aircraft:

- 12 CH-46Es (an entire HMM squadron)
- 4 CH-53Es (a detachment from an HMH squadron)
- 4 AH-1Ws (a detachment from an HMLA squadron)
- 2-3 UH-1Ns (a detachment from an HMLA squadron)
- 6 AV-8Bs (a detachment from a VMA squadron).

The sea-based MEU(SOC) requires the capability to transport forces by air. Currently, MEU(SOC)s typically designate one rifle company as the helicopter company—the one that usually goes ashore by helicopter. A rifle company includes about 180 Marines and officers. With attachments, specific to its assigned mission, a reinforced rifle company could be transported in 8 to 10 MV-22 aircraft (at 24 Marines per aircraft, these could carry 192 to 240 personnel). Since a VMM (the designation for MV-22 squadrons) will include 12 aircraft, it is appropriate to deploy the entire squadron with the MEU. This would maintain unit integrity and continue the practice of building the MEU ACE around a medium-lift squadron.

The MEU(SOC) will continue to have heavy equipment, which the MV-22 cannot transport. It makes sense to continue to include some heavy-lift transport capability (CH-53Es) in the MEU ACE.

In addition, missions such as small-unit insertions or MEDEVACs may not require a MV-22 or CH-53E capability. Having aircraft that can provide light transport for MEU forces provides greater flexibility for the MEU ACE.

Offensive air support (OAS) capabilities are an important force multiplier for the MEU's relatively light ground forces. The battalion landing team (BLT) has weapons organic to the infantry battalion, an artillery battery, and LAV and AAV gun systems.

The MEU ACE's transport helicopters have minimal weapons systems and will often require escort by AH-1Zs and JSF aircraft. Because of range and speed differentials among aircraft, the AH-1Zs will generally accompany the CH-53Es and UH-1Ys, while JSFs provide detached escort for MV-22s.

At times, depending on the enemy threat and situation, there may be a requirement to provide limited anti-air warfare coverage with a combat air patrol (CAP). This requirement would be met by the JSF.

MEU air reconnaissance requirements include reconnoitering likely helicopter routes for some missions and situations, and providing limited area surveillance and reconnaissance. Such missions will likely be performed by JSF and UAVs.

Depending on the complexity of a MEU operation, distance from the amphibious ships, and the mission's complexity, the MEU may need to command and control the operation from an aircraft. The airborne command and control platform will likely be a UH-1Y.

Airborne electronic warfare requirements will be minimal, because of likely MEU missions. The MEU ACE primarily provides support to the ground force in limited operations, rather than operating independently, where airborne electronic warfare capabilities are often used to suppress enemy air defenses. The nature of overall MEU capabilities precludes this MAGTF from operating independently in a very sophisticated threat environment where airborne EW may be required.

Likely future MEU ACE capabilities

This section describes the likely capabilities of the future MEU ACE and how these capabilities may be used by the MEU.

The Marine Corps plans to include the following aircraft in the future MEU ACE:

- MV-22
- CH-53E
- AH-1Z
- UH-1Y
- JSF
- VTUAV.

In 2015 the MEU ACE will have new and modified aircraft that will dramatically improve its capabilities as well as the aviation capabilities of the MEU. The MV-22, AH-1Z, and UH-1Y will all have greater range, speed, and payload than the aircraft they replace, particularly the MV-22. The JSF, which will replace AV-8Bs, will also have greater range and speed than the AV-8B. But more important, the JSF will provide an organic fixed-wing multi-mission capability that the MEU has never had before.

The MEU(SOC) will continue to be a light force that provides forward presence and the capability for quick-reaction crisis response. New MEU ACE capabilities will greatly improve the MEU's operational reach, organic firepower, and organic air reconnaissance capabilities. They will enable MEUs to respond more rapidly and from longer ranges. This will effectively increase the operational reach, and may make MEUs a viable option to respond to more and different types of crises.

NEO scenario analysis

Based on our initial look at the aviation requirements for various MEU missions, we felt that the best scenario to examine in detail was a NEO. In addition to being a very likely mission for a MEU, it is one of the most asset intensive. Depending on the particular situation, a NEO may need to include security operations.

The scenario we examined in detail comes from the MV-22 Concept of Employment (COE), [7]. The COE was written with the input and direction of Warfighting Development Integration Division, Marine Corps Combat Development Command, and the Deputy Commandant for Aviation. It is based on real-world planning that was done by a MEU several years ago for an operation that was not executed.

Scenario

The scenario is a long-range NEO. It also calls for the scenario calls for a TRAP mission, making the overall scenario even more asset intense. Because of the short time line between the warning order and the NEO execution, the MEU will conduct the entire mission with organic assets.

Mission

The NEO takes place in the country of Orange. Orange is currently in the throes of a national rebellion, with the government controlling most urban centers and the rebels controlling most of the countryside. Although the Government of Orange agrees to allow the United States to evacuate its citizens, it does not guarantee their safety. The MEU(SOC) must therefore be prepared to respond to a wide range of threats.

Neighboring countries have refused the United States fly-over rights and access to bases, thus requiring ship-to-objective maneuver (STOM) operations. Evacuees are concentrated at the three sites shown in figure 1: Portside, Seaside, and Sandville.

Figure 1. NEO scenario: country of Orange

A total of 840 evacuees are to be evacuated from the three sites:

- 500 from Portside, on the west coast of Orange
- 40 from Seaside, which is 200 n.mi. east of Portside
- 300 from Sandville, which is in the mountains, at an elevation of 6,000 feet above sea level.

Enemy

Enemy forces are mostly composed of rebel irregulars, armed with small arms, light machine guns and rocket-propelled grenades. There are, however, some regular army units that have joined the rebellion as well. They are equipped with 20 to 24 tanks, 20 to 30 APCs and two batteries (12 tubes) of 122-mm howitzers. The rebels

generally have a low level of technology and have limited NVG capability.

The ground threat, although minimal, does require the MEU to land with some anti-armor and long-range fire capability. Due to the rapid nature of the evolution, artillery will not be brought ashore and any long-range fires will be supplied by the ACE.

The enemy air threat and anti-air threats are similarly unsophisticated. The total offensive air capability consists of four to six operable light helicopters and eight to ten light attack aircraft. Pilots have little night flying experience. The anti-air threat consists of optically guided AAA, some SA-14s, and a few radar-guided surface-to-air missiles (SAMs).

Like the ground threat, the air threat is minimal, but too big to be ignored. Because the MEU is operating on its own, the threat will have to be addressed solely by MEU organic assets.

Terrain and weather

The interior of Orange is mountainous, particularly the region in which Sandville is located.

Troops and support available

The MEU will conduct this short-notice, long-range NEO with only its organic capabilities.

Time available

The situation is deteriorating rapidly in Orange, and the MEU will commence the NEO as soon as it is within aircraft launch range.

MEU concept of operations

The MEU will take advantage of its operational reach to launch at long range, and will use its night vision capability to conduct the entire NEO under cover of darkness.

Marines are inserted into four sites; civilians will be evacuated from three of those sites. The inserted forces will provide security and evacuation assistance.

- One reinforced rifle platoon will be inserted into Seaside. It includes a table of organization (T/O) rifle platoon of 43 Marines, reinforced by an M60 machine-gun squad of 7 Marines and an assault squad of 4 Marines, for a total of 54 Marines.
- One reinforced rifle company minus will be inserted into Sandville. It consists of a T/O rifle company, minus the reinforced platoon sent to Seaside, of 128 Marines and two (Fast Attack Vehicles) FAVs, with 3 Marines each, for a total of 134 Marines.
- One reinforced rifle platoon of 54 Marines will be inserted into Portside. This force is identical to the one inserted into Seaside.
- A second reinforced rifle company minus will be inserted into a blocking position east of Portside in order to defend against a potential attack by a mechanized rebel force.

The concept of operations calls for the Seaside, Sandville, and blocking force insertions to take place concurrently. The insertion into Portside will take place after the other three.

In addition, the following forces will remain on-call, aboard the ARG, throughout the operation:

- One TRAP team of 23 Marines[1].
- One Sparrowhawk (one platoon reinforced, used for additional security and/or reinforcement of forces ashore). Consists of a T/O rifle platoon of 43 Marines, reinforced by an M60 machine-gun squad of 7 Marines and an assault squad of 4 Marines, for a total of 54 Marines.

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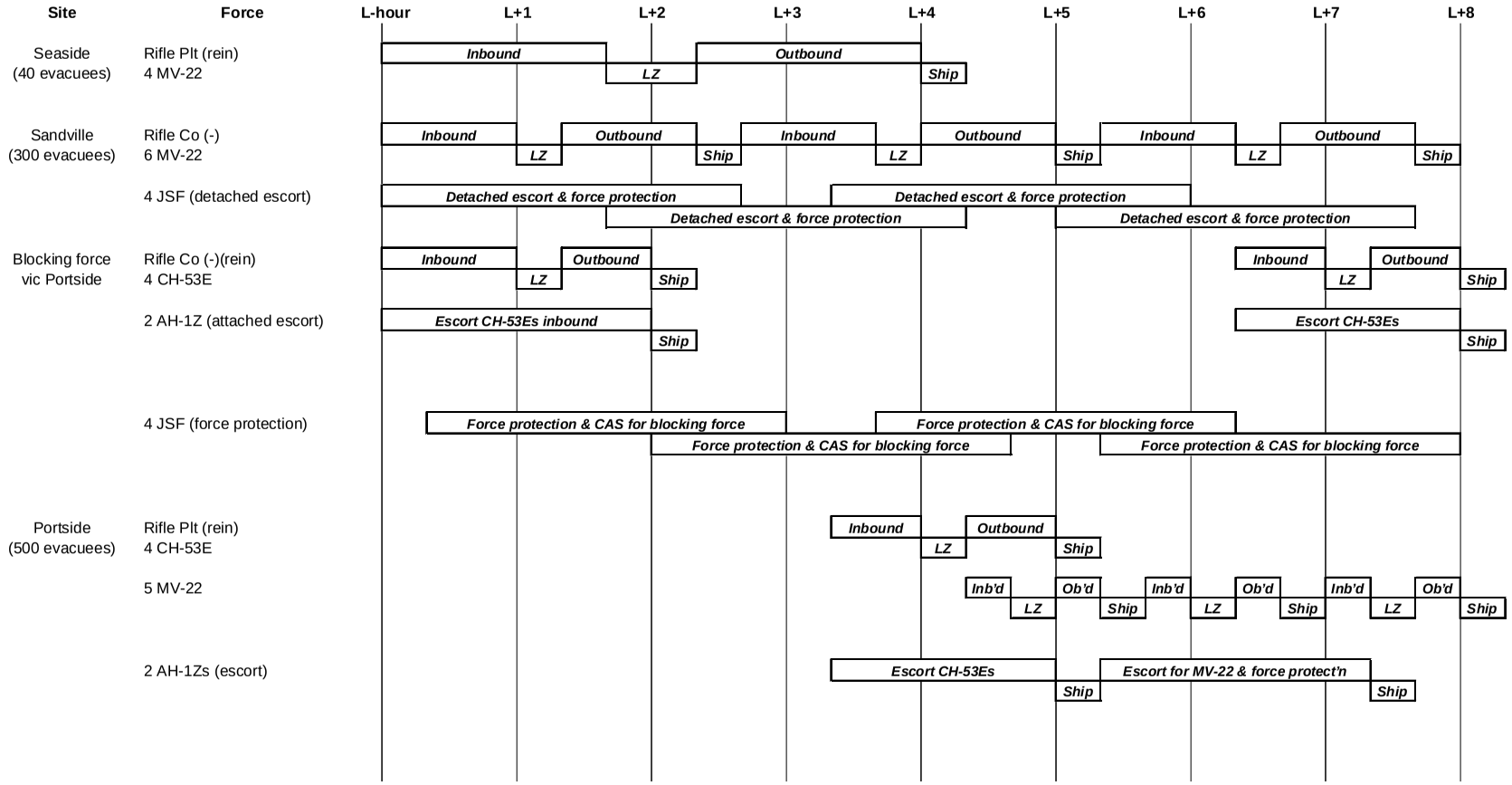
1. The current 26th MEU(SOC) SOP, [6], includes a number of different TRAP packages based on the tactical situation. We chose the baseline TRAP package.

- One Bald Eagle (one company minus, used for additional security and/or reinforcement of forces ashore). Consists of a T/O rifle company, minus the reinforced platoon used in the Sparrowhawk, for a total of 128 Marines.

The MEU concept of operations and an execution time line are presented in figure 2. The execution time line shows what aircraft fly various portions of the mission in 20-minute increments. Because Sandville combines a long distance with a large number of evacuees, it determines the length of the operation, as well as absorbing many of the available assets.

Figure 2. NEO scenario execution time line



NEO scenario and overall MEU aircraft requirements

This section describes the aircraft required to accomplish the NEO mission in accordance with the MEU concept of operations, and overall MEU ACE aircraft requirements by T/M/S aircraft. We factor in aircraft availability to arrive at the total number of aircraft needed in the MEU ACE to accomplish the NEO mission.

MV-22

A maximum of 11 MV-22 are needed at one time to complete the NEO mission as described in the concept of operations. Eleven aircraft can insert and extract the evacuation force and evacuate the non-combatants.

At a minimum, an entire 12-plane VMM squadron should be part of the MEU ACE. A rifle company of about 180 Marines plus attachments could be transported by eight to ten MV-22 (which can carry 192-240 personnel at 24 per aircraft). This would maintain unit integrity and continue the practice of building the MEU ACE around a medium-lift squadron.

In the NEO scenario, when aircraft availability is taken into account, up to 14 MV-22 aircraft are required. This maximum requirement represents more than one full VMM squadron. One could meet this requirement by creating VMM squadrons with more than 12 MV-22, or maintaining 12-plane VMM squadrons and assuming some operational risk for MEU(SOCs). As mentioned earlier, a MEU with 12 MV-22 could execute the NEO as planned with, at times, no aircraft readily available to lift the reserve force when needed, or could stretch out the evacuation by flying more cycles with fewer aircraft.

We recommend that the MEU ACE continue to include an entire 12-plane medium-lift squadron—a VMM in the future.

CH-53E

Four CH-53Es are required to insert and extract the reinforced rifle company (-) that serves as a blocking force. The same CH-53Es are also used to supplement the evacuation of civilians.

The NEO scenario requires six CH-53Es, when aircraft availability is taken into account, to insert and extract the blocking force. Six CH-53Es would also allow the MEU to move its entire six-gun artillery battery in a single lift. Currently, MEUs deploy with a four-plane detachment of CH-53Es. The MEU ACE CH-53E aircraft requirement appears to be six aircraft.

AH-1Zs

Four AH-1Zs are used as attached escort for the CH-53E division, and also provide detached escort/force protection for the MV-22 aircraft that extract civilians from Seaside. The NEO scenario requires a maximum of four AH-1Zs in the air at a given time. Taking aircraft availability into account implies a requirement for six AH-1Zs. The MEU ACE AH-1Z requirement appears to be six aircraft.

UH-1Ys

A UH-1Y inserts and extracts a reconnaissance team that is initially inserted into the Portside area to locate civilians and monitor the situation on the ground. As the execution time line shows, the evacuation of civilians from Portside happens in the latter half of the NEO.

Because this operation occurs at night, another UH-1Y is required for airborne command and control, particularly in the vicinity of Portside where a section of JSF is airborne to provide CAS and force protection to the blocking force, as needed. CH-53Es are being escorted by AH-1Zs, and MV-22 are extracting civilians.

Taking aircraft availability into account implies that three UH-1Ys are required. The MEU ACE UH-1Y requirement appears to be three aircraft.

JSF

Prior to L-hour, a section of JSF aircraft conduct a route reconnaissance flight over Orange to provide information for mission planners. During the actual operation, two sections of JSF provide continuous force protection for the MV-22s and reinforced rifle company (-) conducting the Sandville portion of the NEO. Another two sections of JSF provide continuous force protection to the blocking force in the vicinity of Portside.

Taking aircraft availability into account implies a requirement for ten JSF aircraft. Currently, the MEU ACE includes a six-plane AV-8B detachment from an 18-plane VMA squadron.

The Marine Corps appears to be leaning toward creating 12-plane JSF squadrons. A 12-plane squadron structure would lend itself to deploying 6-plane detachments more readily than a detachment of up to 10 JSF. However, if ten aircraft were deployed with a MEU, perhaps the entire squadron would be chopped to the MEU ACE, with the up-to-ten aircraft deployed with the MEU and the balance of the squadron serving as a CONUS stand-by detachment. The MEU ACE JSF squadron requirement appears to be ten aircraft.

KC-130s

The MEU's standby detachment of two KC-130s does not have a role in the NEO scenario. However, they do play an important role in some MEU missions, and should continue to be part of the MEU ACE.

VTUAV

MEU(SOC) air reconnaissance requirements fall into two types: reconnaissance of likely helicopter routes, beach landing zones, and helicopter landing zones; and more general area coverage. A section of JSF and one VTUAV system (which includes three aerial vehicles) can provide the necessary coverage.

MEU reserve forces

The MEU reserve forces aboard the ARG are intended to react to situations that may occur during the NEO, such as an attack against the blocking force or a downed aircraft. Because of the long distances involved in the NEO and the large number of evacuees, there are several periods of time when no aircraft are available for lifting a reaction force ashore, from the ARG.

Our analysis of this operation implicitly assumes that some operational risk is acceptable. Of course, that operational risk could be minimized by having more aircraft in the MEU(ACE)—in this case, more transport helicopters—or lengthening the execution of the NEO over time by holding some aircraft in reserve for the reaction force, and essentially making more cycles to evacuate the civilians with fewer aircraft.

Summary

Table 3 summarizes NEO aircraft requirements by number of sorties flown, minimum aircraft required, and number required when aircraft availability is taken into account.

Table 3. MEU ACE aircraft requirements for NEO

Aircraft	Sorties[a]	Minimum no. of aircraft required[b]	Aircraft availability	No. of aircraft required[c]
MV-22	37	11	.80	14
CH-53E	12	4	.70	6
AH-1Z	16	4	.75	6
UH-1Y	6	2	.75	3
JSF	18	8	.85	10

a. For transport helicopters, we count each cycle or round trip starting at the ARG as a sortie.
b. This is the maximum number of different aircraft airborne at the same time.
c. This takes aircraft availability into account. We divide the figure in the third column by the availability factor in the fourth column, and round up to the next whole number.

Table 1 summarized the future MEU ACE aircraft requirement. For convenience, the information is given again below, in table 4.

Table 4. Future MEU ACE aircraft requirement

Aircraft type	Current structure	Requirement
MV-22	12	14
CH-53E	4	6
AH-1Z	4	6
UH-1Y	2	3
JSF	6[a]	10
KC-130	2[b]	2
VTUAV	0[c]	1 system

a. The current MEU ACE includes a detachment of six AV-8Bs. The Marine Corps intends to replace all its AV-8Bs with JSF aircraft.
b. This two-plane detachment is not deployed aboard the ARG with the rest of the MEU. It remains in the continental United States as a stand-by detachment, which can be forward-deployed in support of the MEU, at the MEU commander's discretion.
c. There are currently no unmanned aerial vehicles in the MEU ACE. The VTUAV system is a new system that will be in the Marine Corps in the 2015 time frame.

References

[1] A. Jareb. *Marine Aviation Requirements Study: Peacetime Requirements Analysis*, Unclassified, August 2001 (CNA Research Memorandum D0003926.A2)

[2] G. Phillips et al. *Marine Aviation Requirements Study: Summary Report*, Unclassified, August 2001 (CNA Research Memorandum D0003922.A2)

[3] G. Phillips et al. *Marine Aviation Requirements Study: MTW Scenario Analysis*, Unclassified, August 2001 (CNA Research Memorandum D0003923.A2)

[4] G. Phillips et al. *Marine Aviation Requirements Study: SSC Scenario Analysis*, Unclassified, August 2001 (CNA Research Memorandum D0003924.A2)

[5] Marine Corps Order 3120.9A with Change 1, *Policy for Marine Expeditionary Units (Special Operations Capable) (MEU(SOC))*, Nov 1997

[6] 26th MEU(SOC), *Standard Operating Procedures (SOP)* (U), Secret, 2001

[7] Marine Corps Combat Development Command, *MV-22 Concept of Employment*, 27 July 2000

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